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Title:	Evaluation of Synthetic Diamond Detectors for Fast Neutron and X-ray Detection
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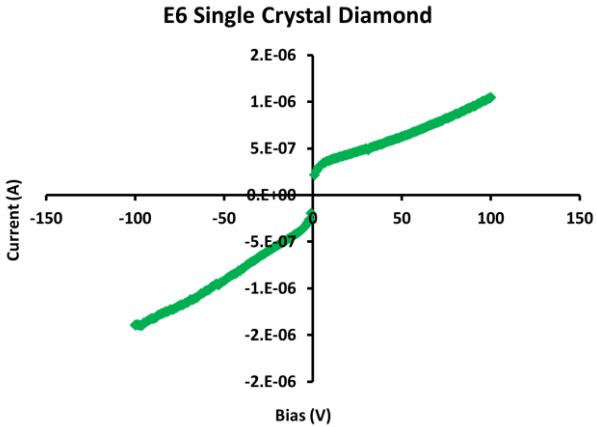
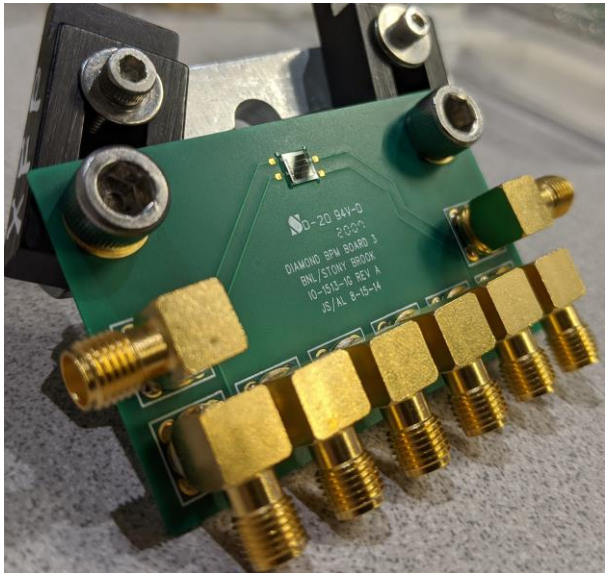
Detector Testing at NSLS-II

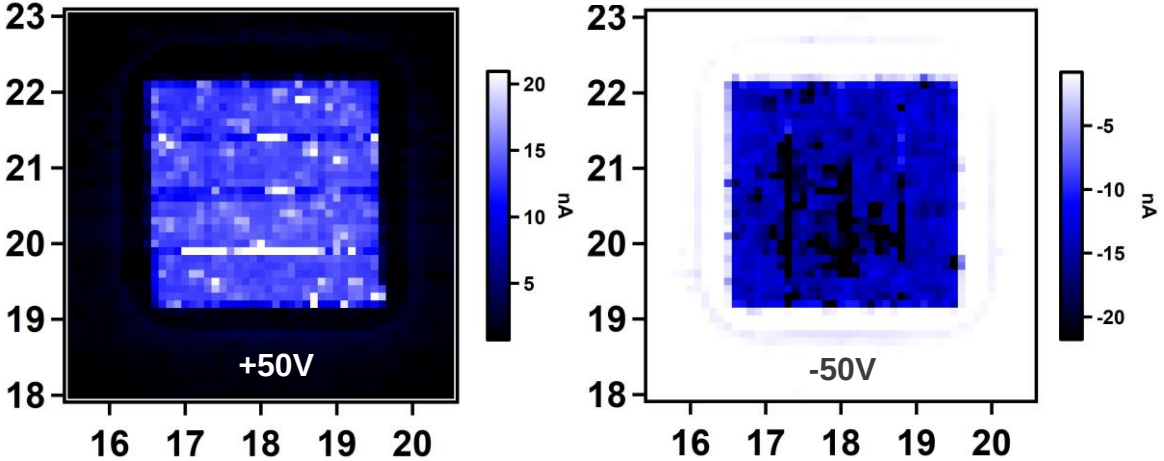
- Nitrogen environment
- Integrated motion control
- Multiple calibration options
  - Ion chamber
  - Diamond detectors (previously characterized)
  - Copper block calorimeter
- Variable x-ray beam sizes (25um – 2mm) and intensity (up to 10^{16} ph/s)
- Standard Measurements:
  - I-V curve measurement (response wrt bias)
  - X-ray beam-induced current (XBIC) measurements (response uniformity)

Element 6 Electronic Grade Single Crystal Diamond (standard)

- Element 6 (foreign (UK) vendor)
- 4 x 4 mm^2 electronic grade single crystal diamond (0.5 mm thick), patterned as 4 x 4 strips
- Standard usage in the field
- Adequate, but surprisingly not excellent performance

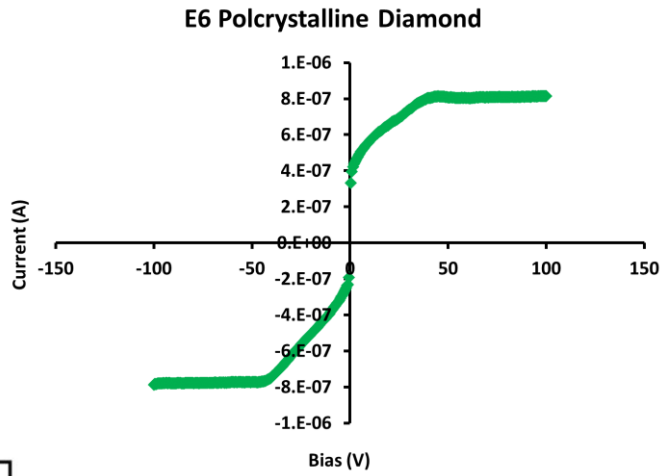


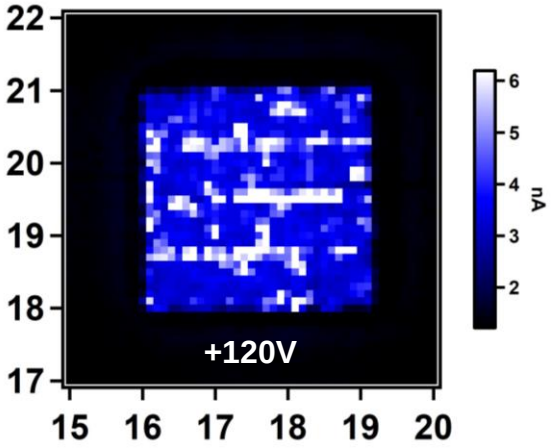


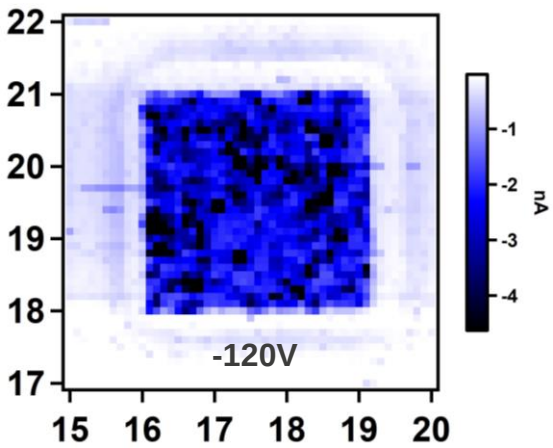


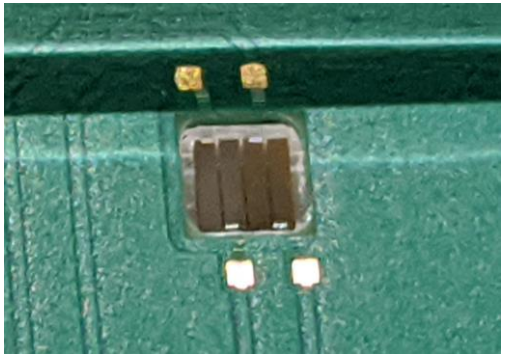
Element 6 Electronic Grade Polycrystalline Diamond (standard)

- Element 6 (foreign (UK) vendor)
- 4 x 4 mm^2 electronic grade polycrystalline diamond (0.3 mm thick), identical package and pattern as single crystal unit
- Standard usage in the field
- Best specimen shown (excellent performance) – several others had surprisingly poor performance



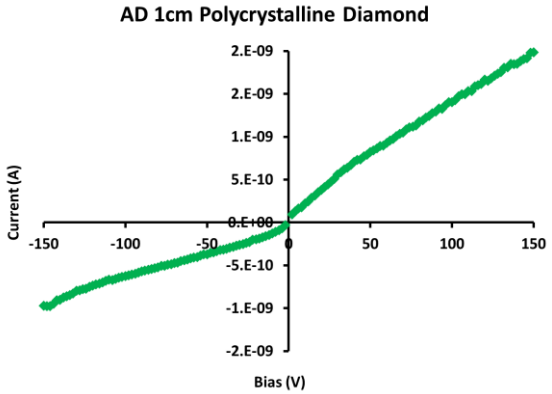


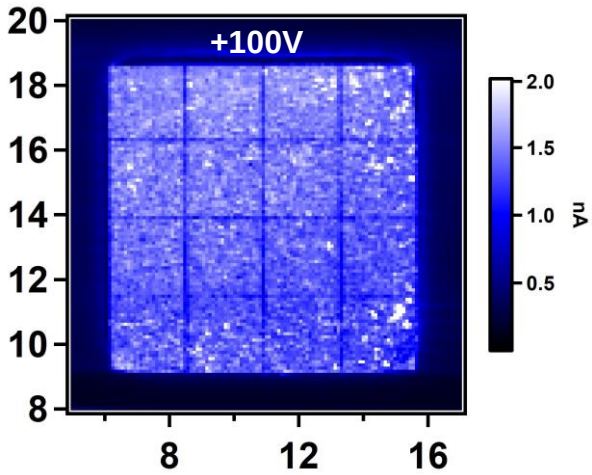


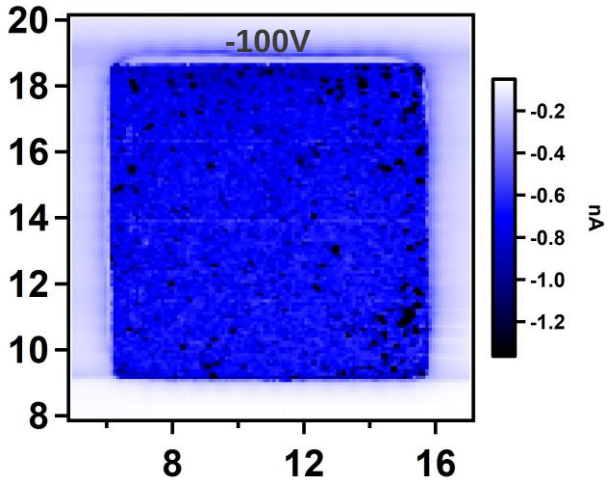


Large Area Polycrystalline Diamond (Applied Diamond)

- Applied Diamond (US small business)
- 1 cm^2 electronic grade polycrystalline diamond (0.25 mm thick)
- Large area, reasonably uniform
- Lacks full charge collection – requires calibration

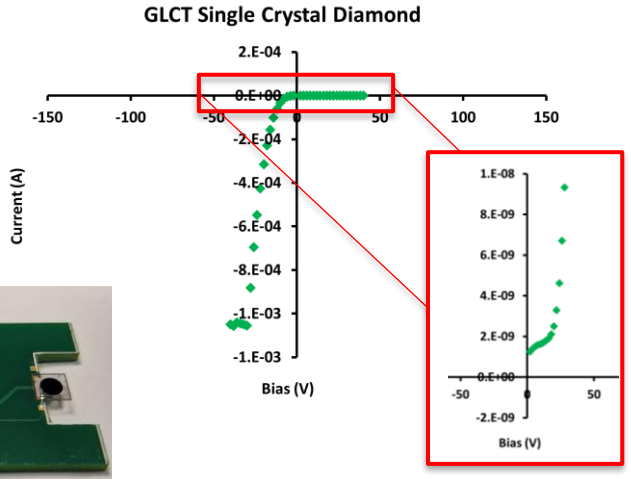


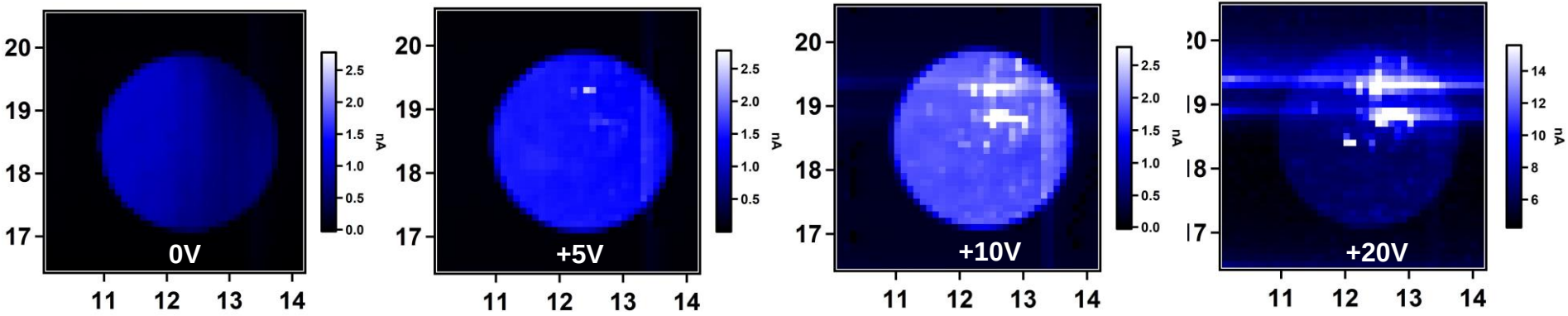




New Vendor for Single Crystal Diamond (GLCT)

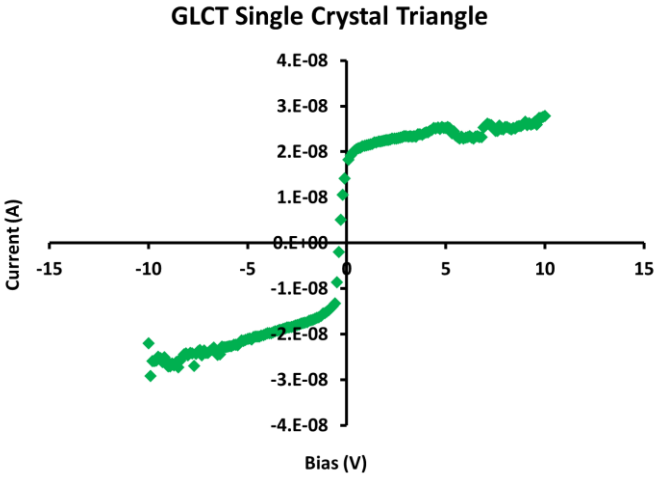
- Great Lakes Crystal Technology (US small business)
- 4 x 4 mm^2 electronic grade single crystal diamond (0.15 mm thick)
- At least 2 significant photoconductive spots
- Not usable with negative bias
- Ok at 5V, but not much higher

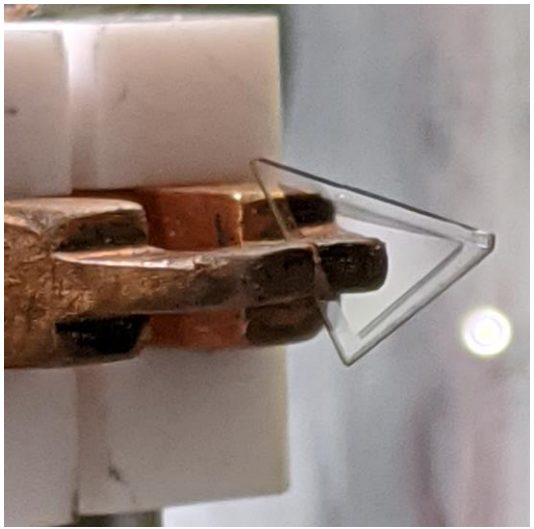


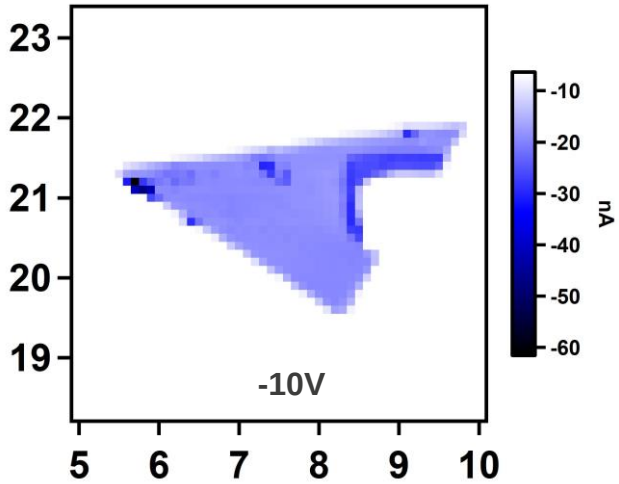


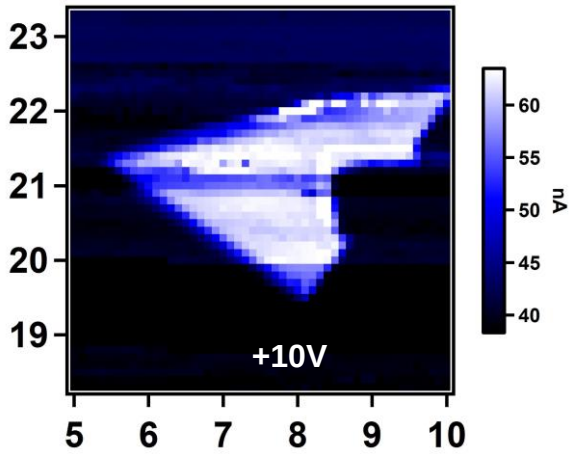
New Vendor for Single Crystal Diamond (GLCT) 2nd Sample Promising

- Great Lakes Crystal Technology (US small business)
- 4 x 4 mm^2 electronic grade single crystal diamond (0.1 mm thick), cracked into 2 triangular pieces
- Good bias response, fairly good uniformity
- GLCT shows promise! Needs to continue to work on the product – should watch their progress ☺









Results and Conclusions

- Element6 has come out of a two year production pause (pre-COVID) with material that lacks their previous QC – some is excellent, but screening is needed
- Applied Diamond can now make usable polycrystalline material, for applications not requiring absolute flux calibration. Large area possible ($1cm^2$).
- Great Lakes Crystal Technology has made great progress in two years, but still needs development to become a trusted supplier of single crystal material.
- LANL staff (Dongsung Kim) has developed proficient lithography and bonding expertise at CINT to make devices from vendor supplied material.
- LANL staff has continued and expanded capabilities for device testing at NSLS-II